

Virginia Space Grant Consortium (VSGC)
Lead Institution: Virginia Space Grant Consortium, an Affiliate of the
Old Dominion University Research Foundation
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Consortium URL: <http://www.vsgc.odu.edu>
Grant Number: NNX10AT94H

PROGRAM DESCRIPTION

The National Space Grant College and Fellowship Program consists of 52 state-based, university-led Space Grant Consortia in each of the 50 states plus the District of Columbia and the Commonwealth of Puerto Rico. Annually, each consortium receives funds to develop and implement student fellowships and scholarships programs; interdisciplinary space-related research infrastructure, education, and public service programs; and cooperative initiatives with industry, research laboratories, and state, local, and other governments. Space Grant operates at the intersection of NASA's interest as implemented by alignment with the Mission Directorates and the state's interests. Although it is primarily a higher education program, Space Grant programs encompass the entire length of the education pipeline, including elementary/secondary and informal education. The Virginia Space Grant Consortium is a Designated Consortium funded at a level of \$575,000 for fiscal year 2011.

PROGRAM GOALS and OBJECTIVES

VSGC Goal 1 - Conduct quality scholarship and fellowship programs including a bridge program for freshman and sophomore students, research awards for undergraduate and graduate students, community college STEM scholarships and teacher education STEM scholarships.

1.A: Each academic year, award students in all five categories with scholarships and fellowships. Students will be competitively selected by review panels consisting of representatives from member institutions. Metric: Review panel for each program reports on the process and total number of awards; **1.B:** Award at least the minimum amount required by NASA in scholarship and fellowships to at least 60 students each academic year. Metric: Total amount awarded to total number of students in the five scholarship/fellowship categories; **1.C:** Each academic year, provide a percentage of awards to underrepresented minority and female students that is consistent with the diversity target as established by NASA (currently 24.6%). Metric: Total awards to minority students divided by total awards to all students; **1.D:** At least 90% of students receiving research awards will attend and present at the annual VSGC Student Research Conference. Metric: Total number of research awardees presenting at conference divided by total number of research awardees; **1.E:** Longitudinally track 100% of all students receiving significant awards to identify their next step in academia or the workforce. Metric: Total number of students longitudinally tracked to next step divided by total awardees; **1.F:** At least 60% of students receiving significant awards will be employed by NASA, an aerospace contractor, higher education or other educational

institutions. Metric: Total number of students employed in these categories divided by total number of awards; **1.G**: At least 45% of undergraduate students receiving significant support from VSGC will move on to advanced education in NASA-related disciplines in their next step. Metric: Total number of students in advanced education in these categories divided by total number of awards.

VSGC Goal 2 - Offer quality higher education programs including internship programs in partnership with our member institutions and partners.

2.A: Each academic year, provide paid internships for at least 4 students at NASA Centers or with industry partners. Metric: Number of students placed in internships

2.B: Conduct at least one annual higher education project in partnership with Virginia's community colleges. Metric: Number of collaborative projects with community colleges or the System office; **2.C**: Each year, conduct at least two higher education projects in partnership with VSGC member institutions. Metric: Number of collaborative projects with members.

VSGC Goal 3 - Promote diversity in all programs and activities by encouraging participation by underrepresented minority and female students and faculty.

3.A: Each year, conduct at least one outreach event in partnership with Hampton University (HBCU) to promote programs and opportunities to students and faculty. Metric: One HU outreach event; **3.B**: Each year, conduct at least one outreach event in

partnership with a non-member minority institution to promote programs and opportunities to students and faculty. Metric: One non-member MSI outreach program; **3.C**: Each academic year, provide a percentage of student awards to underrepresented minority and female students that meets or exceeds the diversity target as established by NASA (currently 24.6% for underrepresented minorities and 40% females). Metric:

Total awards to minorities divided by total number of awards; **3.D**: Provide at least one STEM program each year for special needs faculty or students. Metric: Number of programs provided; **3.E**: Undertake at least one collaborative program with a non-member minority serving institution each year. Metric: Number of programs provided.

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VSGC Goal 4 – Undertake programs that foster research capabilities at our member institutions and serve as a catalyst for linking university researchers to NASA and other opportunities.

4.A: Conduct a New Investigator award program each year targeting tenure track faculty who are within the first five years of their academic career. At least five awards will be given annually and the research will have NASA relevance. Metric: Number of awards provided; **4.B**: Disseminate at least 20 research opportunity announcements to statewide networks each year. Metric: Number of announcements disseminated; **4.C**: Facilitate at

least five meetings with university researchers and NASA personnel, as appropriate, resulting in at least two collaborative proposals being submitted. Metric: Number of proposals submitted; **4.D**: Support at least two experiential student research, mission and design programs each year. Metric: Number of programs supported.

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Goal 5 – Provide quality precollege educational opportunities including professional development for precollege and pre-service educators and student-focused programs for students throughout the precollege pipeline.

5.B: VSGC will reach over 100 students by conducting selected student-focused programs and activities promoting participation in STEM and related careers. Metric: Total number of precollege students participating in student-focused programs; **5.C:** At least 75% of precollege educators participating in more than two days of professional development will use NASA resources in their classroom following the workshop. Metric: Total number of educators indicating they will use NASA resources in the classroom on a post-event survey divided by total respondents to survey; **5.D:** At least 60% of precollege educators receiving NASA resources or participating in VSGC-led short duration activities will use NASA resources in their classroom. Metric: Total number of educators indicating they will use NASA resources in the classroom on a post-event survey divided by total respondents to survey; **5.E:** At least 50% of all precollege students participating in VSGC-sponsored programs will express an interest in STEM careers. Metric: Total number of students indicating they have an interest in a STEM career on a post-event survey divided by total respondents to survey.

Goal 6 - Conduct Informal Science Education programs in partnership with informal education members and partners.

6.A: Sponsor at least one program each year with the Virginia Air and Space Center or the Science Museum of Virginia. VSGC will consider other appropriate informal science education opportunities as funding and partnerships permit with the goal of providing at least one other activity per year if funding and resources permit.

Goal 7 - Serve as an effective steward of Consortium resources and a strong partner for STEM programs.

7.A: Effectively leverage NASA Space Grant resources. Metric: NASA Space Grant funding will be leveraged by at least 3 dollars to 1 NASA Space Grant Dollar as evidenced in Consortium year-end Matching/Contributed Funding Report; **7.B:** Network with other Space Grants and Space Grant organizations. Metric: Evidence of networking and program partnerships; **7.C:** Network with NASA Headquarters and NASA Centers for program implementation. Metric: Evidence of networking and program partnerships; **7.D:** Build and sustain effective strategic partnerships, including relationships with state and federal legislators and officials. Metric: Evidence of state and federal support for VSGC programs and documented attendance by these individuals at select activities and events; **7.E:** Number of program partners working with VSGC each year. Metric: At least 30 non-member partners per year.

PROGRAM/PROJECT BENEFIT TO OUTCOME (1, 2, OR 3)

NASA Education Outcome 1 –

Minnae Chabwera, a 2010-11 VSGC Undergraduate STEM Bridge scholar, is a rising senior physics major at Hampton University. She was a LARSS intern for the summer of 2011 and was awarded a VSGC Undergraduate Research Scholarship for 2012-13. She hopes to continue on to graduate school and plans on conducting cross-disciplinary

research that will allow her to become an asset in multiple arenas. Her research interests include airborne high-speed vehicles and radiation effects. She plans to continue on to Ph.D. degree and hopes to work for NASA as an astronaut.

NASA Education Outcome 2 – VSGC provided three engineering technology-themed STEM Exploratory Saturday programs for 208 middle school grade students and 197 parents. These events were very successful in meeting objectives and powerful demonstrations of community partnerships as events were hosted by Thomas Nelson Community College, Canon Virginia, and NASA Langley Research Center.

Five students who participated in the Virginia Aerospace Science and Technology Scholars Program (VASTS) are finalists in the international science competition-Conrad Foundation "Spirit of Innovation Challenge," named after Pete Conrad-NASA Astronaut and sponsored by Lockheed Martin. They are one of five finalist teams in the Aerospace Exploration category. The team from various locations in Virginia met and formed while participating in VASTS. The team is developing an economically viable plan for mining rare Earth minerals from nearby asteroids using existing technologies. The team is coached by an AP Physics teacher and advised by scientists the students met through VASTS. The team presented their final proposal at the "Innovation Summit" at NASA Ames Research Center in California March 28-31, 2012.

PROGRAM ACCOMPLISHMENTS

VSGC actively works with its members and many external partners to accomplish Consortium goals. NASA's funding investment is heavily leveraged by external funding from federal and state agencies and other nongovernmental sources. The external funding enhanced the VSGC's ability to staff and run a wide range of program in concert with NASA goals.

NASA Education Outcome 1

Scholarship/Fellowship/Internships (VSGC Goals 1-3)

For the 2012-13 academic year, the VSGC awarded \$295,000 in scholarships and fellowships from NASA Space Grant and State matching funds (\$170,000) to 66 students attending Virginia universities. VSGC met all goals and objectives and exceeded the diversity target by awarding 29% to minorities and 40% to female students. All students will be tracked to their next step and reported in the future.

- \$195,000 went to 40 students for graduate research fellowships; Additional matching funds of \$263,755 to support graduate research awards were also provided by member institutions.
- \$85,000 went to 11 students for undergraduate research scholarships
- \$15,000 went to 15 sophomore students majoring in STEM through the Undergraduate STEM Bridge scholarship program.

During FY11, VSGC held the annual Student Research Conference where research awardees presented their research. In April 2012, the College of William and Mary hosted the conference and sponsored the luncheon in honor of the awardees. VSGC met the student attendance goal as 98% of research awardees attended and presented their

research. The event was also attended by faculty and NASA personnel, industry representatives, state legislators, and members of the Governor's Council. Remarks were made by the Secretary of Transportation and the Deputy Secretary of Technology. The Deputy Secretary of Education attended.

VSGC also provided \$42,000 in funding to eight students to support internships and travel for summer 2011:

- Space Grant NASA Science Mission Directorate (SMD) internship program through a placement at the Chandra Observatory
- Student internship at NASA Wallops Flight Facility through OSSISOLAR
- Two student internships at the NASA Academy at Marshall
- Student internship at the Aeronautics Academy at NASA Langley
- Student internship at the Aeronautics Academy at NASA Glenn
- Two student internships at NASA Academy at Ames

Higher Education (VSGC Goal 2)

All objectives within VSGC's Higher Education Goal 2 were met. VSGC collaborated with the Virginia Community College System, a Consortium member, and 3 colleges on an externally funded project to support geospatial pathways. No funds were requested for STEM programs for students or faculty with special needs. VSGC will continue to seek partnerships in this area. VSGC collaborated with several member institutions for higher education projects as described below.

- VSGC held forum-style meetings with administrators and faculty from STEM disciplines at Virginia State University (VSU) and Norfolk State University (NSU) (both HBCU's) to discuss collaborative projects and developing joint proposals. This effort led to one proposal currently being developed with VSU and ODU to target female freshman engineering majors with retention strategies and academic support.
- VSGC provided Norfolk State University, an HBCU, with \$2,000 to support four undergraduate students majoring in STEM disciplines to serve as research mentors to ten high school students during the 4-week NSU STEP program.
- VSGC, in partnership with Colorado Space Grant Consortium offered a RockOn! workshop in June 2012. RockOn! is a workshop for faculty and students where participant teams learn to build a small sounding rocket payload and launch it on a sounding rocket at NASA's Wallops Flight Facility. VSGC assembled the payload kits. The hardware in the kit will be able to be used on future custom RockSat payloads and possibly CubeSat flights. Full impact data will be reported by the Colorado Space Grant Consortium.
- VSGC offered a competitive proposal and award process for VSGC Innovative Projects during FY11. VSGC invited proposals in three areas of interest:
 1. Development of new higher education STEM courses with NASA relevance.
 2. Support for Student Flight projects.
 3. Professional Development programs for Middle School Teachers.

Of the four VSGC-supported projects through this process, two were in Higher Education:

- Virginia Tech, "Nitric Oxide and Dust Detector Experiment for RockSat-X and Falling Spheres Data Analyses (NODDEX)": Virginia Tech's RockSat-X interdisciplinary team of twelve undergraduates and one graduate student are designing and building a sounding rocket payload for launch in the 2012 RockSat-X Program. NODDEX will include an optical Nitric Oxide (NO_x) sensor, a Piezo Dust Detector (PDD) CubeSat instrument, two inertial measurement units (IMU's), and an aperture vacuum seal release mechanism for the Space Barometer (S-Bar) CubeSat instrument.
- University of Virginia (UVA), "JefferSat Student Flight Project": UVA has initiated a student design, build and fly satellite project called JefferSat. The goal of the mission is to exploit the characteristics of smart phones (such as Android and iPhone devices) in order to enhance the capabilities of satellites while simultaneously reducing mission cost and time scales. The research objective is to demonstrate Earth sensing and data capture, as well as spacecraft navigation and control using a commercially available smart phone. The educational objective is to make the on-orbit images and data captured by the smart phone available to the public in order to promote an understanding of STEM fields related to space flight. The JefferSat mission is an undergraduate student focused project that is integrated with the existing curriculum for aerospace and mechanical engineering senior students.

Research Infrastructure (VSGC Goal 4)

VSGC met all objectives in Goal 4 including disseminating more than 20 research opportunities, facilitating meetings to discuss proposals, sponsoring at least 2 experiential research opportunities and offering the New Investigator Program (NIP). VSGC offers the NIP to strengthen Virginia's research infrastructure by providing startup funding to early career faculty from member institutions conducting research that is directly aligned with NASA's mission. Five faculty members from VSGC-member institutions received an award of \$10,000 each for their research project related to NASA missions and activities.

- Dr. Phil Arras, University of Virginia, Department of Astronomy. Research: Physics of Extrasolar Planet Atmospheres, Interiors and Orbits.
- Dr. Stella B. Bondi, Old Dominion University, Department of Engineering Technology. Research: Fiber Reinforced Polymer and Composite Material-Analyzing Mechanical Properties.
- Dr. K. Todd Lowe, Virginia Tech, Aerospace & Ocean Engineering Department. Research: Demonstration of a 16 Simultaneous Point, Spatio-Temporally Resolved Flow Thermometry Technique for High Speed Flow Research.
- Dr. Iordanka N. Panayotova, Old Dominion University, Department of Mathematics & Statistics. Research: High Altitude Clear Air Atmospheric Turbulence: Improving the Forecasting through Increasing the Fundamental Understanding of Causes and Mechanisms Leading to Turbulence.
- Dr. Kristin Wustholz, College of William & Mary, Department of Chemistry. Research: Enhancing the Electron Transfer of Dye-Sensitized Solar Cells Using Single Molecule Microscopy.

NASA Education Outcome 2

Higher Education (VSGC Goal 7)

The Director and staff annually brief the Virginia Congressional representatives and the state delegation. VSGC works with state officials and legislators to assist with STEM and aerospace policy advocacy. The Director serves on the Governor's Aerospace Advisory Council. The Council consists of legislative, industry, and other members. VSGC serves as a key advisor for STEM education on the council. The Director is also a member of and co-facilitates with the NASA Langley Research Center Director the Informal Aerospace Working Group of about a dozen aerospace sector leaders also including the NASA Wallops Director, the Directors of the Mid-Atlantic Regional Spaceport, National Institute of Aerospace, and the Virginia Department of Aviation as well as industry representation. The goal of the group is collaboration for STEM education and workforce development as well as aerospace advocacy for the Commonwealth including extensive planning for the Commonwealth's annual Aerospace Day and supporting events. VSGC is responsible for coordination of aerospace sector messages for the meetings with state policy makers for this event.

The VSGC Director and staff participate in activities such as Aerospace Day (February 2012) in Richmond, the Virginia Science Education Leadership Association, Virginia Society for Technology in Education, and the Virginia Association of Science Teachers. VSGC has helped to successfully advocate for engineering standards of learning at the precollege level. State cabinet officials and state legislators have participated in VSGC programs such as the Student Research Conference and the Virginia Aerospace Science and Technology Scholars (VASTS) program. Nearly all state legislators have been active in recognizing VASTS Scholars from their districts.

VSGC was asked to submit STEM initiatives to the General Assembly for the 2012-14 biennium. Four initiatives were funded at a level of \$738,000 per year. This brings annual state support to VSGC to \$1,433,000.

Precollege Programs (VSGC Goal 5)

VSGC's suite of precollege programs includes projects targeting both students and teachers and aligns with NASA's areas of emphasis. Follow-up surveys were conducted of all participating teachers. VSGC met all Goal 5 objectives reaching over 100 students with 100% expressing an interest in STEM careers. VSGC provided teacher professional development with augmentation funding.

- VSGC coordinated three engineering technology-themed STEM Exploratory Saturday programs for 208 middle school grade students and 197 parents through the Governor's Academy for Innovation, Technology, and Engineering (GAITE) in partnership with Thomas Nelson Community College (TNCC), NASA Langley Research Center, Northrop Grumman, and Canon Virginia. TNCC hosted a Saturday and provided a college campus experience for the students.
- VSGC supported the cash prizes for the three winners of the Virginia State Science Fair.

- As part of its efforts to build aerospace programs in rural southwest Virginia, VSGC sponsored an ISS Downlink event hosted by Wise County Public Schools. The event was attended by more than 4,000 students from the five-county region.
- VSGC provided Russell County Public Schools with \$3,000 to support their participation in the Student Spaceflight Experiments Program (SSEP). Located in rural southwest Virginia, Russell County was one of 11 communities selected to participate in SSEP Mission 2. Nearly 400 students participated and submitted 26 proposals for experiments on the International Space Station (ISS). One experiment will be selected to be flown to the ISS.
- VSGC supported two precollege projects through the VSGC Innovative Projects competitive proposal process described in detail in the Higher Education section.
 - University of Virginia, “Space Science for Middle School Teachers”: The University of Virginia Department of Astronomy and the Curry School of Education are collaborating to implement an astronomy and space science professional development course for middle school teachers. Faculty will provide a 5-day workshop plus academic year follow-up. Teachers will have the opportunity to borrow telescopes to use with their classes as part of the NASA-funded CLUSTER program. Teachers will earn 3 graduate credit hours for participating in the course and follow up activities.
 - Hampton University, “Science Overdrive: Professional Development for Middle School Science Teachers”: HU provided a 3-day professional development workshop for 20 middle school science teachers in the Richmond area. Teachers were provided with materials, activity worksheets, and presentation to take back to their classrooms. Workshop instructors created excitement for and confidence in science teaching by providing an increased depth of content knowledge and awareness of new applications for science concepts. The 3 interactive workshop days covered the following topics: Forces (day 1), Waves (day 2), and Light (day 3). These topics were chosen after a general survey of local middle school teachers identified them as topics they were most interested in enhancing in their curriculum.

NASA Education Outcome 3

Informal Education Programs (VSGC Goal 6)

No base space grant funding was spent on informal education. Activity for this goal will be summarized in the augmentation funds report.

PROGRAM CONTRIBUTIONS TO PART MEASURES

- **Student data and Longitudinal Tracking**: Total awards = 91; Fellowship/Scholarship/Internships = 74, Higher Education/Research Infrastructure = 17; 29% of the total awards represent underrepresented minority funding and 40% of the total awards were to female students. Since 2006, 64 students have graduated and are pursuing an advanced STEM degree; 21 students have accepted STEM positions in the aerospace industry; 26 students are employed in STEM in a non-aerospace industry; 11 students are employed by NASA; 18 are employed in a STEM academic field in higher education, and; 23 students are employed in K12 STEM.

- **Diversity:** In addition to the 14 affiliate members, VSGC partnered with several non-member institutions, including two HBCU's, other Virginia institutions, and business/industry to provide programs and support to pre-college and higher education students. VSGC supported a student from Virginia State University (VSU) for an internship with NASA Ames Research Center. VSGC also provided NSU with funds to support students serving as research mentors to high school students. Sixty-percent of the faculty supported with NIP research awards were female. VSGC awarded 29% of scholarships/fellowships to minority students with 40% of awards to female students. Through the Undergraduate STEM Bridge scholarship program, VSGC supported 25 underrepresented minority sophomore students with a scholarship to assist in their investigation of STEM-related research including undergraduate student mentor support. Both precollege projects supported through the Innovative Projects awards specifically targeted teachers from underserved and underrepresented areas.
- **Minority Serving Institutions:** VSGC presented scholarship/fellowship and research opportunities to faculty and students at Hampton University (HU) during visits to the campus. HU hosted a lunch and learn event for undergraduate and graduate students majoring in STEM to learn about scholarship/fellowship opportunities. VSGC was also invited to present at a Department Chair meeting in the School of Science at HU. HU received a precollege project through the VSGC's Innovative Projects process. VSGC is collaborating with ODU and Virginia State University (VSU) on a proposal to NSF's Student Talent Expansion Program (NSF STEP). In addition to the HBCU initiatives noted in the Diversity section above, VSGC also served as a sponsor for an NSU faculty member to do research at NASA Langley (no funding was required).
- **Education Priorities Alignment:** VSGC scholarship/fellowship and higher education programs align with all of NASA's educational priorities including authentic, hands-on student experiences in science and engineering disciplines rooted in NASA-related issues, and the incorporation of real-life problem-solving and needs as context for activities. Several student research projects focused on NASA research priorities such as traditional aeronautics disciplines and climate change. Supported projects reflect diversity in institutions, faculty and student participants. Existing partnerships with community colleges are strengthened through these projects, and VSGC increased the amount of the community college scholarship and awarded scholarships at two colleges without previous awardees.

In support of a NASA Space Grant area of emphasis, VSGC provided the New Investigator Program to strengthen Virginia's research infrastructure by providing startup funding to early career faculty from member institutions conducting research that is directly aligned with NASA's mission. VSGC's suite of precollege programs includes projects targeting both students and teachers and aligns with NASA's areas of emphasis. Several projects engage middle school teachers in hands-on curriculum enhancement capabilities through exposure to NASA scientific and technical expertise and support teachers' ability to provide authentic, hands-on middle school student experiences in STEM. Follow-up surveys were conducted of all participating teachers. One space grant-funded project provided Saturday programs for high school

students on a college campus with the objective of increased enrollment in STEM disciplines and interest in STEM careers.

IMPROVEMENTS MADE IN THE PAST YEAR

- VSGC increased staff by .5 FTE during the FY11 year from Consortium member funding.
- FY11 was an excellent year for VSGC externally funded programs with 11 proposals awarded out of 16 submitted with 3 proposals still pending and 2 proposals declined. Total amount awarded to VSGC was \$4.3 million with \$2.3 million pending in external funding (represents total amount awarded for several multi-year projects).
- VSGC continued to enhance state government engagement in Consortium programs and secured an additional \$100,000 in state support for the VASTS program and an additional \$738,000 for three new STEM initiatives: Commonwealth Industry Internship Program for undergraduate students in partnership with Virginia's Regional Technology Councils and Virginia's institutions of higher education; the Virginia Space Coast Academy for rising tenth graders with NASA Wallops and the Mid-Atlantic Regional Spaceport; and a STEM On-campus Residential Program for rising ninth and tenth graders.
- Participation in VSGC programs by state legislators and members of the Governor's Cabinet and staff of federal legislators continues to grow.
- ODU has provided expanded office space to VSGC as a host institution matching contribution.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

VSGC members and partners play active roles in project development and implementation. In some cases, VSGC provides funding directly to member institutions for projects and the member institution has the lead. In other projects, VSGC staff may take the lead for project coordination working closely with partners for project execution. For competitive opportunities, the VSGC uses a panel of member and sometimes external representatives to make selections of which students or faculty to fund.

VSGC Affiliate members include: College of William and Mary, Hampton University, Old Dominion University, University of Virginia, Virginia Polytechnic Institute and State University, NASA Langley Research Center, NASA Goddard Space Flight Center's Wallops Flight Facility, Science Museum of Virginia, State Council of High Education for Virginia, Virginia Community College System, Virginia Department of Education, MathScience Innovation Center, Virginia Air and Space Center, and Virginia's Center for Innovative Technology.

VSGC scholarships and fellowships are open only to students attending affiliate institutions, including all 23 community colleges. Internship support is available to students attending any Virginia higher education institution. VSGC partners not only with affiliates but with many other organizations and institutions including industry and

NASA Centers on projects. NASA Langley and NASA Wallops were key partners in several VSGC projects.